Instruction Manual

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P6047 PROBE

Tektronix, Inc.
P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-0628-01

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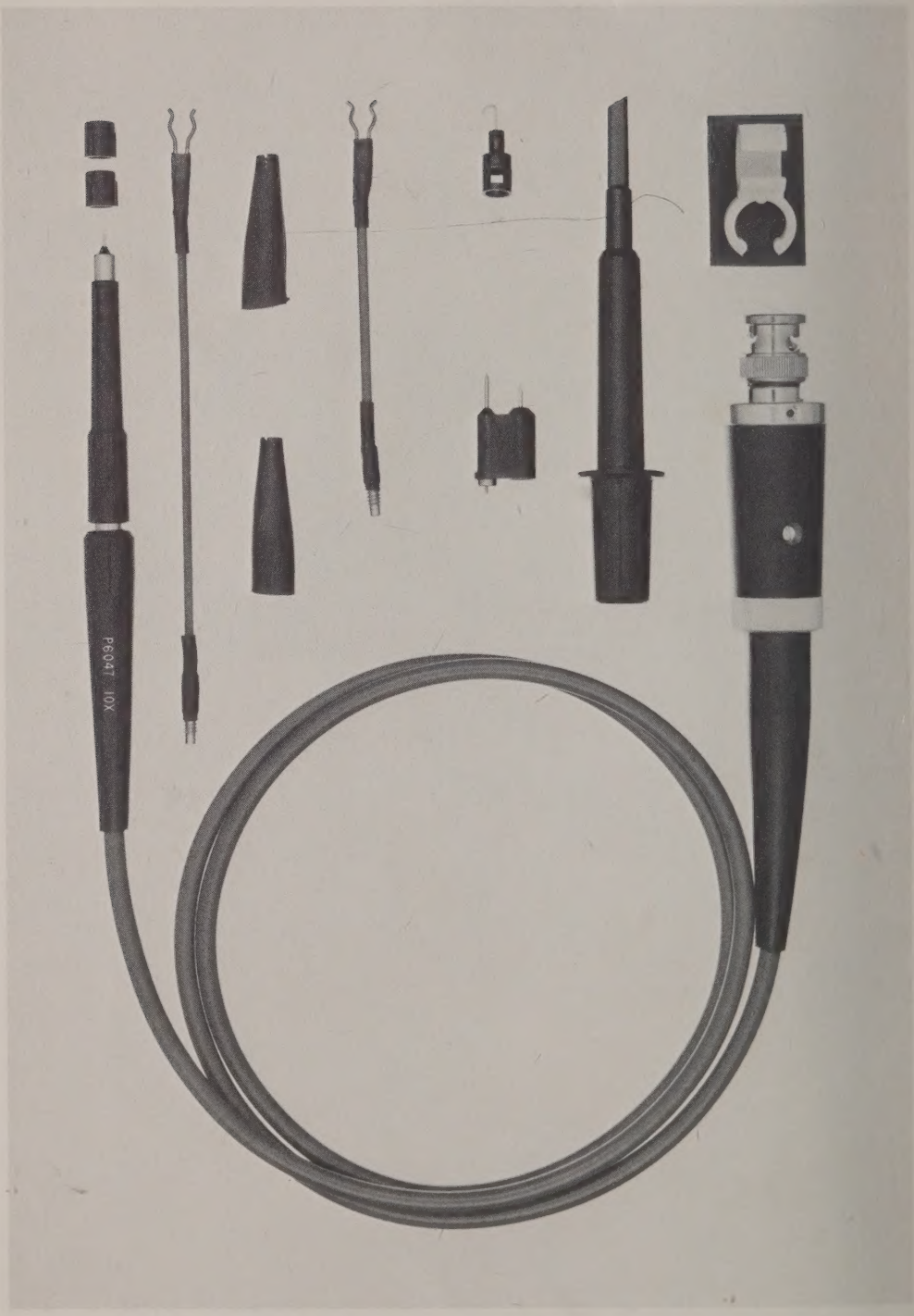

Fig. 1-1. P6047 Probe with standard accessories.

SECTION 1

CHARACTERISTICS

General Information

The P6047 Probe is a passive 10× attenuation probe with a frequency response of DC to 290 MHz. It can be compensated for oscilloscopes or plug-in units having an input impedance of 1 megohm paralleled by 15 to 20 picofarads and is factory calibrated for 20 picofarads.

The probe consists of a small-diameter probe body assembly, which is especially useful in compact circuitry, a 3.5-foot or a 6-foot cable, and a compensating box with a BNC connector.

The compensating box houses a network which provides optimum transient response when the probe is used with wideband oscilloscopes. The probe compensation networks for the two cable lengths differ slightly from one another. The probe can be low-frequency compensated to match the input of the instrument being used by adjusting the variable capacitor through the hole in the compensating box cover. Internal adjustments are provided for high-frequency compensation.

CHARACTERISTICS

Bandwidth

The bandwidth of the P6047 Probe is DC to 290 MHz.

Input Impedance

The input impedance of the probe is 10 megohms paralleled by less than 10.3 picofarads for the 3.5-foot cable and less than 12 picofarads for the 6-foot cable, at 140 kHz. See Figs. 1-2 and 1-3 for input impedance vs. frequency curves.

Compensating Range

The probe can be compensated for oscilloscopes or plug-in units having an input capacitance of 15 to 20 picofarads.

Attenuation

Attenuation is 10×, ±2% with plug-in or oscilloscope having 1-megohm input resistance.

Voltage Rating

The maximum DC + AC peak input voltage is 500 volts, continuous wave (CW). See Fig. 1-4 for derating curves.

Transient Response

The risetime of the probe is ≤1.2 nanoseconds.

The maximum ringing, rounding, and overshoot is ≤3%.

The maximum tilt is ≤2%.

Connecting Cable

The cable is made with a special resistive center which provides critical damping of reflections.

Environmental Capabilities

The probe will operate normally at temperatures from −30°C to +65°C, and at altitudes to 15,000 feet.

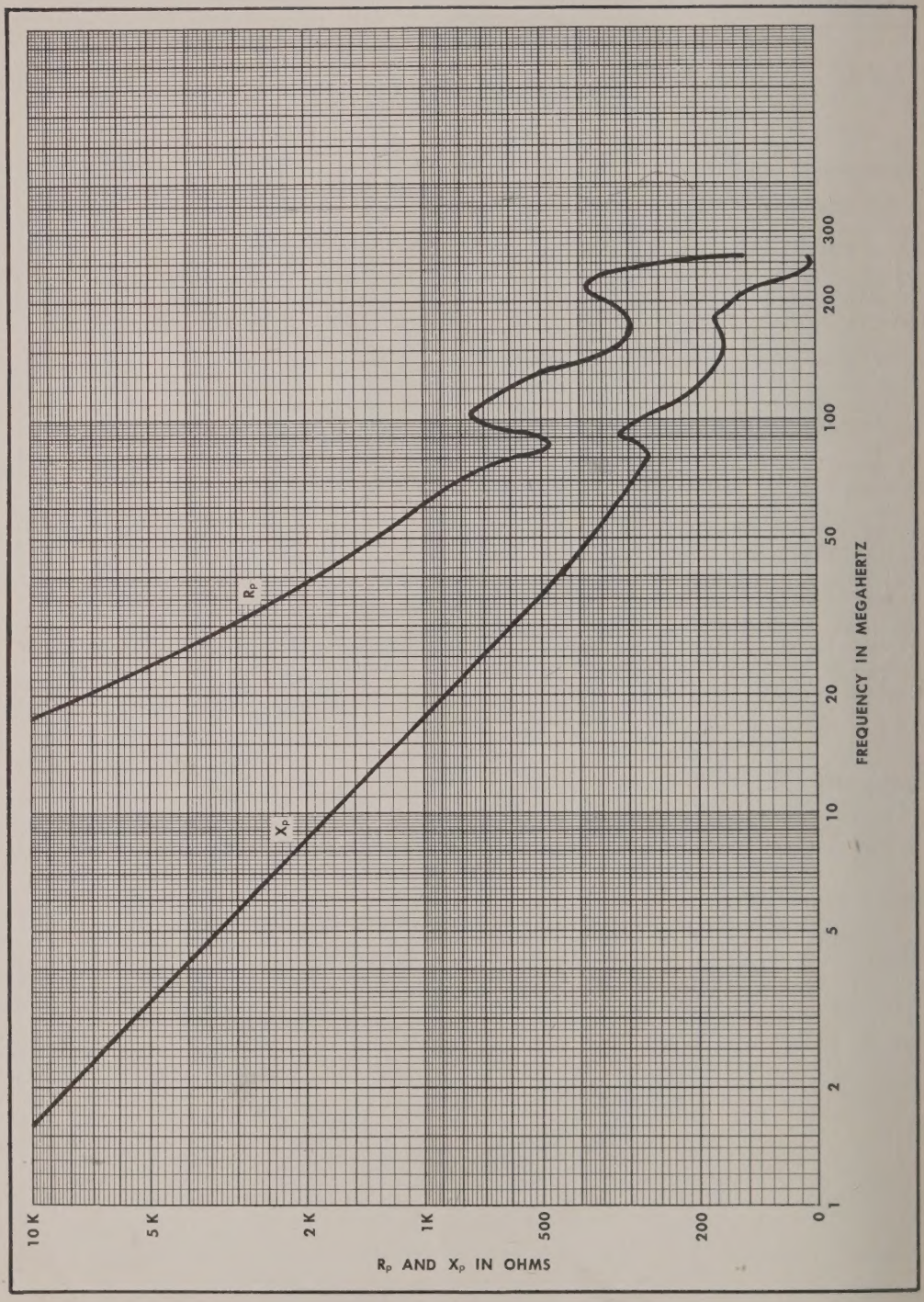

Fig. 1-2. P6047 Input Resistance and Reactance vs. Frequency curves, 3.5-foot Cable.

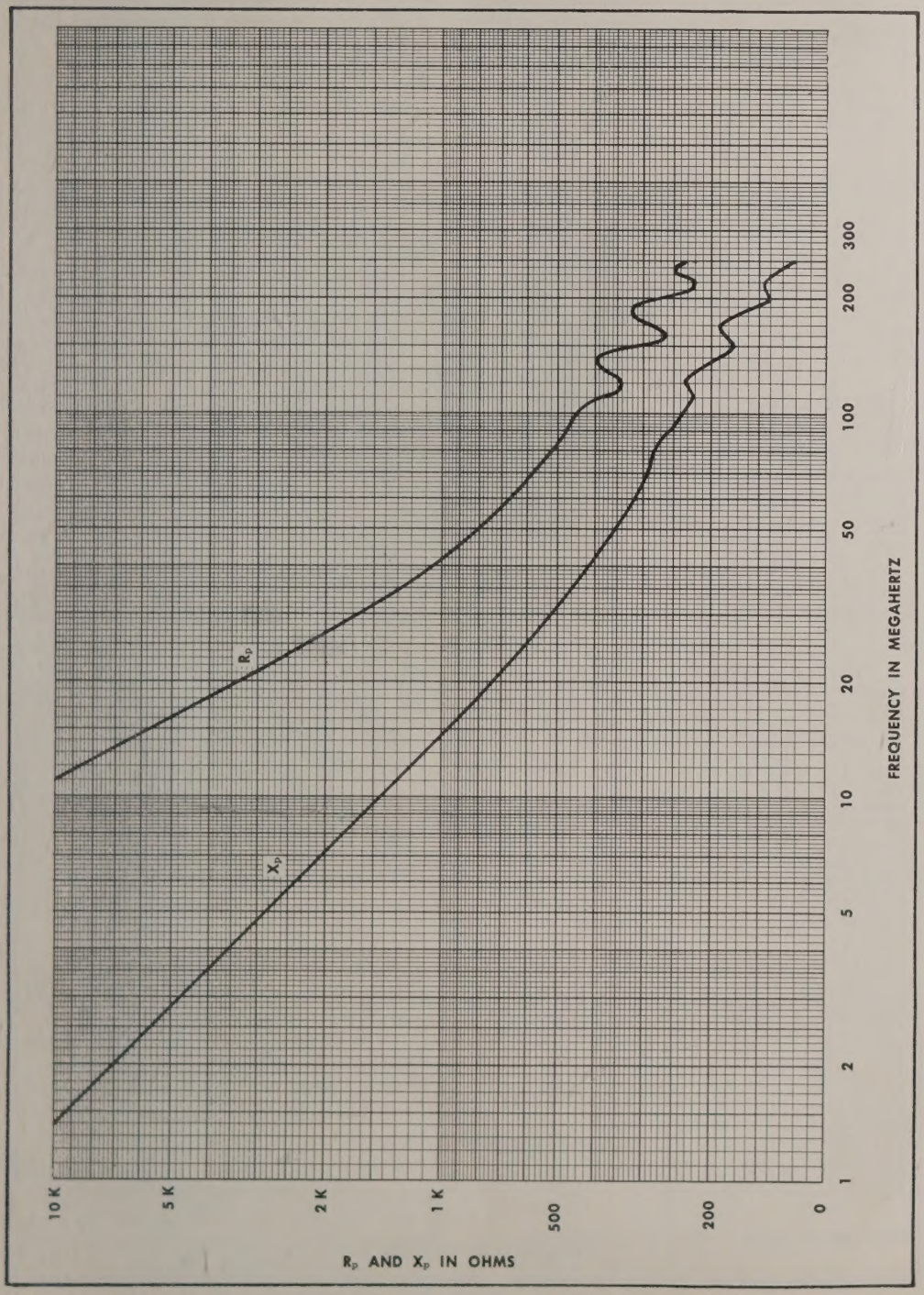

Fig. 1-3. P6047 Input Resistance and Reactance vs. Frequency curves, 6-foot Cable.

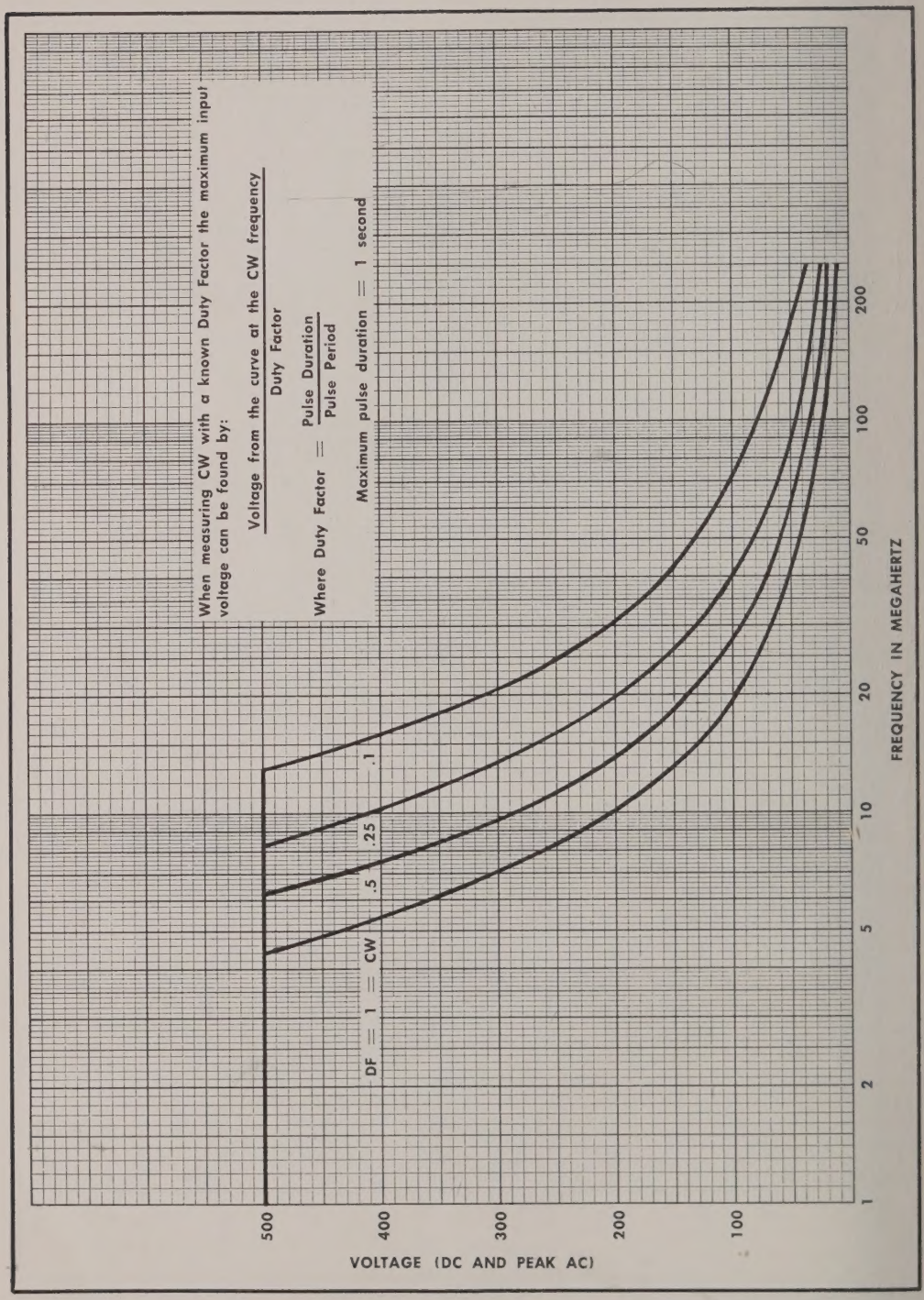

Fig. 1-4. P6047 Maximum Applied Voltage at Specific Duty Factors.

SECTION 2
OPERATING INSTRUCTIONS

General Information

The P6047 Probe enables you to connect an oscilloscope into a circuit with minimum loading and without impedance matching. Due to slight variations in input capacitance between instruments, even of the same type, it is necessary to compensate the probe whenever changing from one instrument to another. Recheck compensation before making critical measurements. Lack of compensation can cause measurement error since both waveshape and amplitude of the display are affected. The probe is provided with an adjustment to match the probe time constant to the time constant of the instrument. The following procedure should be used to compensate the probe.

Compensation

1. Set the oscilloscope calibrator for an output of suitable amplitude.

2. Touch the probe tip to the calibrator output connector.

3. Set the sweep rate to display several cycles of the calibrator signal.

4. Through the hole in the compensating box cover, rotate the capacitor (C9) with a small nonconducting screwdriver to obtain a flat-top presentation of the calibrator output signal. See Fig. 2-1.

NOTE

The P6047 Probe has been factory-calibrated for oscilloscopes having an input capacitance of 20 picofarads. The high frequency response of the probe should be checked periodically, or when changing from one oscilloscope input capacitance to another. Refer to the Calibration section of this manual.

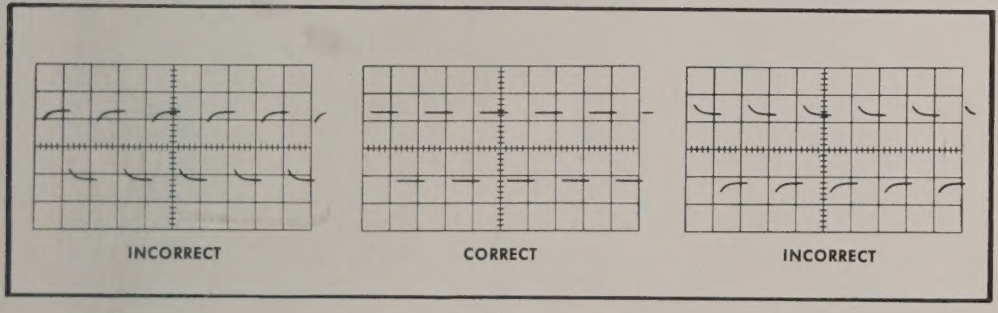

Fig. 2-1. Probe Compensation.

ACCESSORIES

Bayonet Ground Adapter

The Bayonet Ground Adapter provides a convenient means of connecting the probe to the signal source when a ground point is nearby. Place the ground pin on the ground connection and push down until the probe tip contacts the signal source.

Ground Lead

The Ground Lead clips to the probe between the probe body and the cable assembly. Use the short Ground Lead whenever possible, especially when observing high-frequency waveforms.

Insulating Sleeve

When the ground lead is connected to the probe, place the insulting sleeve over the exposed connection to avoid short circuits.

Miniature Alligator Clip

The insulated Alligator Clip screws into the Ground Lead.

Hook Tip

The Hook Tip provides a stable means of holding onto a test point.

Retractable Hook Tip

The Retractable Hook Tip provides a positive connection to a test point. The spring in the tip allows the operator to leave the probe connected to the test point while making adjustments or performing functions elsewhere.

Insulating Tube

When using the probe without one of the above tips, place an insulating tube over the tip of the probe to avoid short circuits.

Probe Holder

The Probe Holder provides a place to store the probe when not in use. After connecting the probe to the instrument being used, place the wide half of the Probe Holder around the cable and slide onto the tapered portion of the cable assembly near the compensating box. When the probe is not in use, place the tapered portion near the probe body into the holder. See Fig. 2-2.

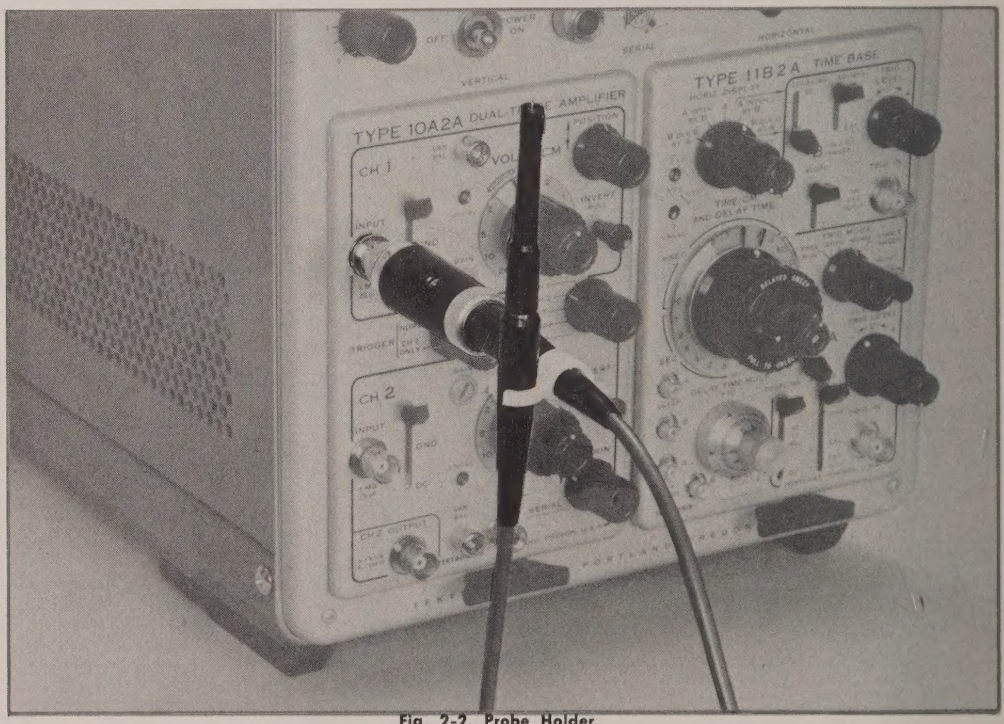

Fig. 2-2. Probe Holder.

SECTION 3

MAINTENANCE

The P6047 Probe is designed to withstand normal operation and handling and should give many hours of continuous use without failure. However, if the probe fails or breaks, replacement parts are available. See Mechanical and Electrical parts lists in Section 5. Fig. 3-1 and Fig. 3-2 show location of electrical parts.

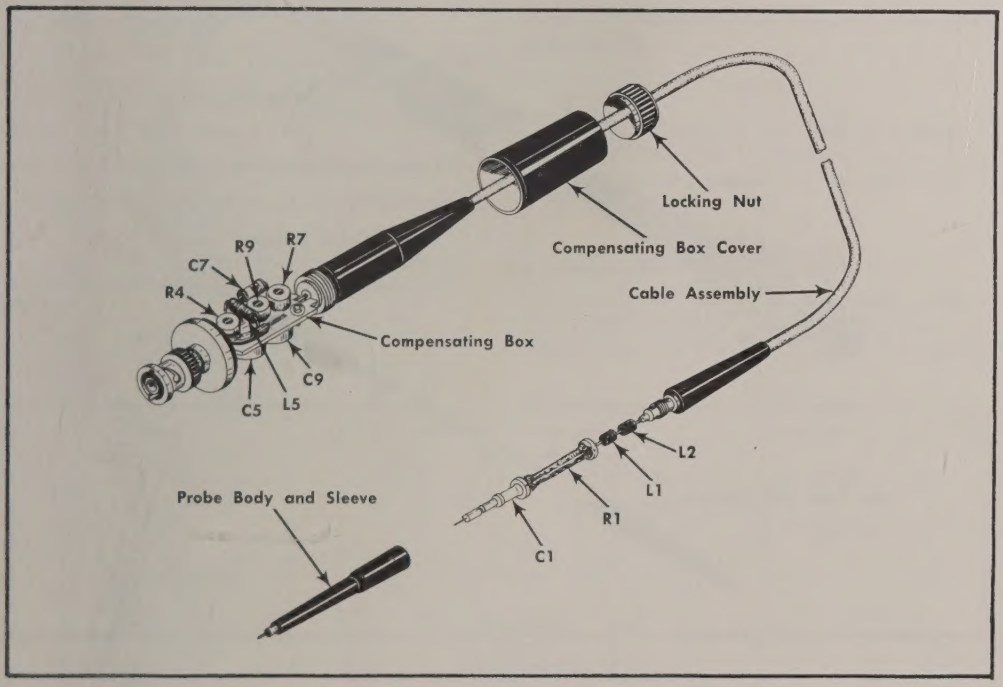

Fig. 3-1. Probe Assembly, 3.5-foot Cable.

Replacing Cable Assembly

If the coaxial cable between the probe and compensating box should fail, the cable assembly is available complete with fittings and cable reliefs. Replace the cable assembly as follows:

1. Remove the compensating box cover by unscrewing the locking nut.

2. Remove the snap ring holding the compensating box to the cable assembly.

3. Unsolder the connection to the end of the cable assembly, using a heat sink, and separate the compensating box from the cable assembly.

4. Unscrew the probe body and sleeve assembly from the other end of the cable assembly.

5. Unsolder the parallel resistor and capacitor from the cable assembly, again using a heat sink.

6. Install the new cable assembly by reversing the above procedure.

7. After the probe is re-assembled, compensate as described in Section 2. Then compensate for high frequencies according to the procedure given in Section 4.

Replacing Components

To replace any electrical parts in either the compensating box or the probe tip you will need a phillips head screwdriver, a pair of long-nose pliers, and a soldering iron.

Avoid excessive heat and repeated soldering on the circuit board to preserve the bond between the conducting material and the board.

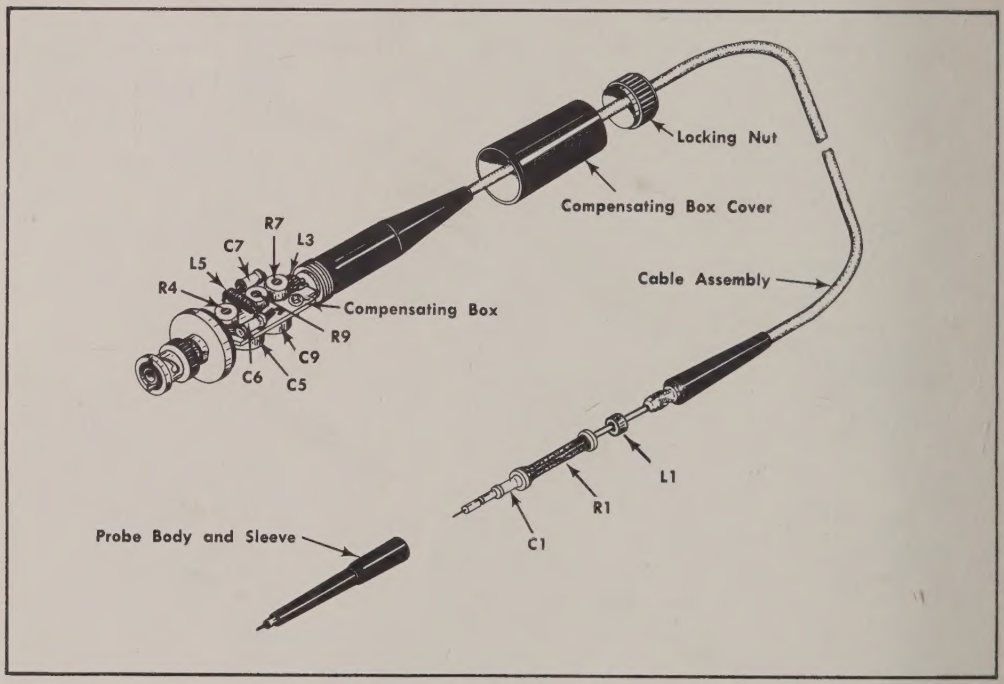

Fig. 3-2. Probe Assembly, 6-foot Cable.

SECTION 4

CALIBRATION

The P6047 has been designed for use with instruments having an input impedance of 1 megohm paralleled by 15 to 20 picofarads, and is factory-calibrated for 20 picofarads. The high frequency response of the probe should be checked periodically, or when changing from one oscilloscope input capacitance to another.

Equipment Required

1. Fast-rise Test Oscilloscope with sweep rate of 0.1 μsec/cm and 10× magnification, such as Tektronix Type 454 or Type 647A with 10A2A and 11B2A plug-in units.

2. 50 Ω Pulse Generator (Tektronix Type 109).

3. 60 nanosecond Transmission Line (Tektronix Type 113 Delay Cable).

4. Two 50 Ω Coaxial Cables—5 nanosecond lengths of RG-8A/U with GR connectors. (017-0502-00).

5. GR-to-BNC Adapter (017-0063-00).

6. 50 Ω BNC Termination (011-0049-00).

7. BNC-to-Probe Adapter (013-0084-00).

8. Reactance Meter (Tektronix Type 130).

9. Constant Amplitude Signal Generator (Tektronix Type 191).

10. 50 Ω Coaxial Cable—with BNC connectors (012-0057-00).

NOTE

Before completing the high-frequency calibration, adjust C9 (low-frequency compensation capacitor) as described in Section 2.

1. High Frequency Calibration

a. Using the two RG-8A/U cables, connect the Type 113 Delay Cable to the Type 109 Charge Line connectors. Connect the GR-to-

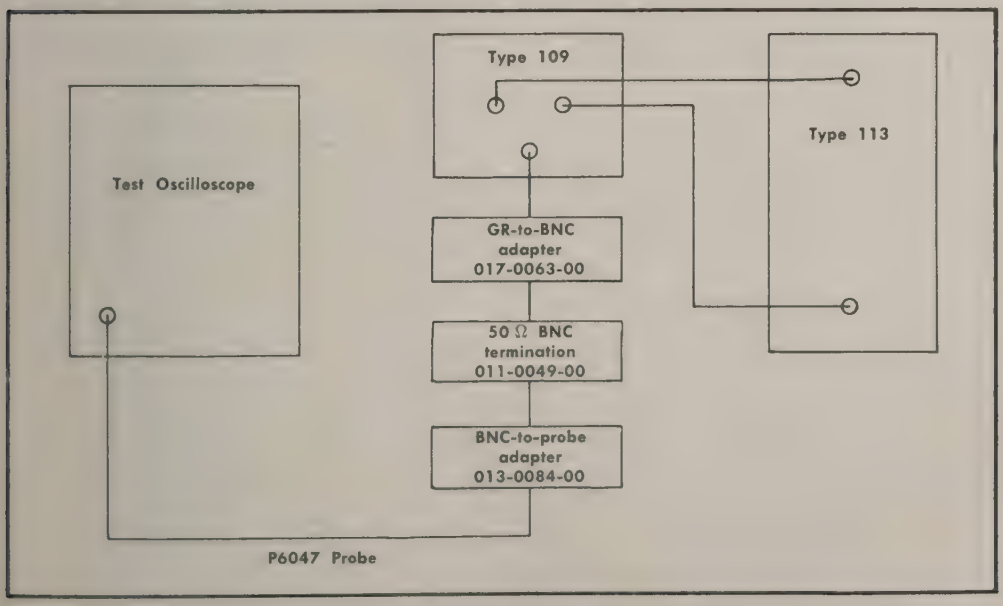

Fig. 4-1. Block Layout of test equipment.

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BNC adapter, the 50 Ω termination, and the BNC-to-probe adapter to the output of the Type 109. Connect the P6047 Probe to the test oscilloscope input connector and insert the probe tip into the probe adapter. See Fig. 4-1.

b. Set the test oscilloscope controls as follows:

Triggering Mode	Normal
Slope	+
Coupling	AC
Source	Internal
Time/cm	0.1 μs
Variable (Time/cm)	Calibrated
10× Magnifier	Off
Volts/cm	20 mV

c. Set the Type 109 Voltage Range switch to 5, Pulse Polarity to +, and adjust test oscilloscope Triggering Level for a stable display. Adjust Type 109 Amplitude for 4 cm of deflection.

d. Using a non-conducting screwdriver, adjust R4, R7, R9, and C5 for the best flat-top and leading edge on the waveform. See Fig. 4-2.

2. Ringing, Rounding, and Overshoot Check

With the controls set as described in the previous step, check ringing, rounding, and overshoot for ≤3%, in addition to that of the test oscilloscope.

3. Risetime Check

The P6047 is designed to have a bandwidth of 290 megahertz and a risetime of 1.2 nanoseconds. Since this response is considerably faster than that of the test equipment commercially available, the probe risetime must be calculated from comparison of system bandwidth measurements taken with and without the probe.

a. With the reactance meter, measure the input capacitance of the oscilloscope or plug-in unit being used (C_1 in the following formula).

b. Assuming that the source impedance of the constant amplitude signal generator used to measure the bandwidth is 25 Ω (50 Ω output impedance terminated in 50 Ω), calculate the risetime of the input of the oscilloscope by:

$$tr_1 = 2.2\,RC = 2.2 \times 25 \times C_1$$

c. Connect the constant amplitude signal generator, terminated in 50 Ω, to the oscilloscope input and measure the bandwidth at —3 dB (BW_1 in the following formula).

d. Calculate the risetime of the oscilloscope when driven by a zero source impedance generator by:

$$tr_2 = \left[\left(\frac{.35}{BW_1}\right)^2 - tr_1{}^2\right]^{1/2}$$

e. Connect the P6047 Probe to the input of the oscilloscope and measure, with the reactance meter, the input capacitance of the probe (C_2 in the following formula).

f. Calculate the risetime of the input of the probe by:

$$tr_3 = 2.2\,RC = 2.2 \times 25 \times C_2$$

g. Connect the P6047 Probe to the output of the constant amplitude signal generator, terminated in 50 Ω, and measure the bandwidth at —3 dB (BW_2 in the following formula).

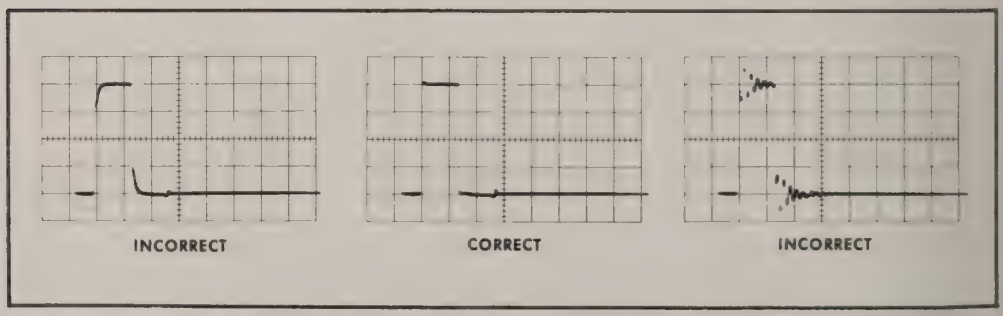

Fig. 4-2. High Frequency Calibration.

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h. Calculate the risetime of the P6047 Probe when driven by a zero source impedance generator by:

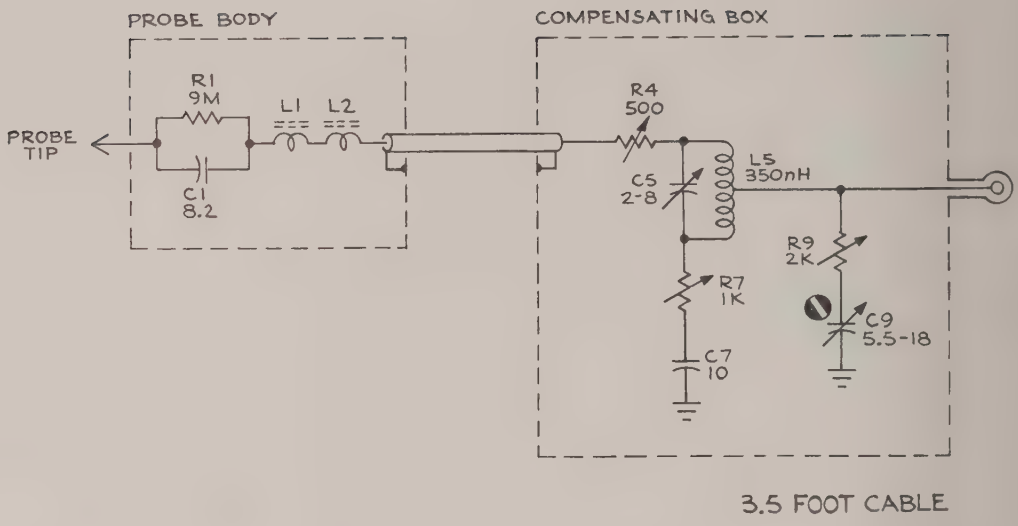
$$tr_4 = \left[\left(\frac{.35}{BW_2} \right)^2 - tr_2^2 - tr_3^2 \right]^{1/2}$$

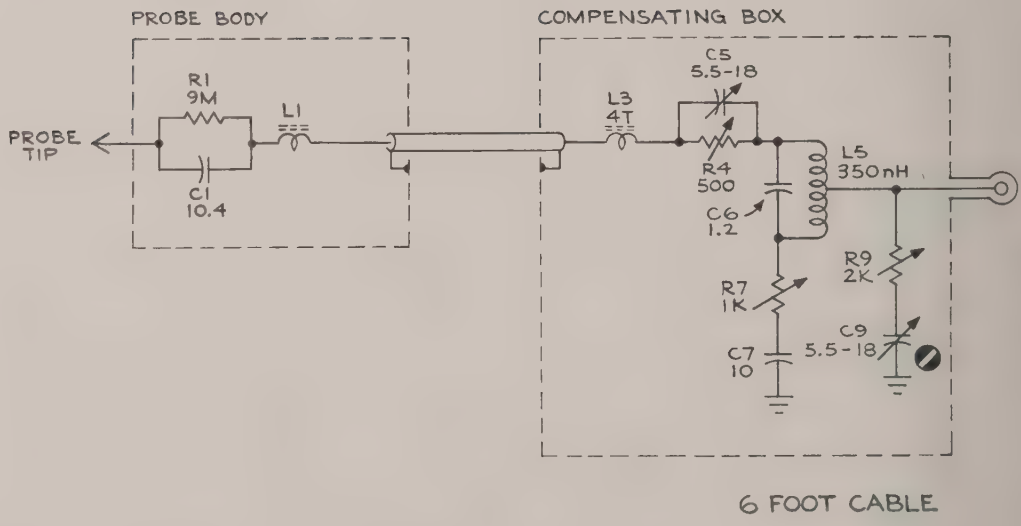
4. Attenuation Check

a. Connect the BNC-to-probe adapter and probe to the Calibrator output (set to 1 volt).

b. With the Volts/cm control set to 20 mV, display several cycles of the Calibrator waveform.

c. Check for a 5 cm display on the test oscilloscope, ±2%. This specification does not include any error present in the test oscilloscope Calibrator or input attenuator.





P6047 10X PROBE

ELECTRICAL PARTS 3.5-FOOT CABLE

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Capacitors			
Tolerance ±20% unless otherwise indicated.							
C1[1]	281-0645-00			8.2 pF	Cer	500 V	±0.25 pF
C5	281-0091-00			2-8 pF, Var	Cer		
C7	281-0634-00			10 pF	Cer	500 V	±0.25 pF
C9	281-0093-00			5.5-18 pF, Var	Cer		
				Inductors			
L1	276-0528-00			Core, Ferramic Suppressor 0.1 μH			
L2	276-0507-00			Core, Ferramic Suppressor 0.6 μH			
L5	*108-0424-00			350 nH			
				Resistors			
Resistors are fixed, composition, ±10% unless otherwise indicated.							
R1[1]	325-0021-00	9 MΩ	1/4 W		Prec	1%	
R4	311-0634-00	500 Ω, Var					
R7	311-0635-00	1 kΩ, Var					
R9	311-0609-00	2 kΩ, Var					

[1]Also available in Attenuator Assembly, Tektronix Part No. *206-0147-00.

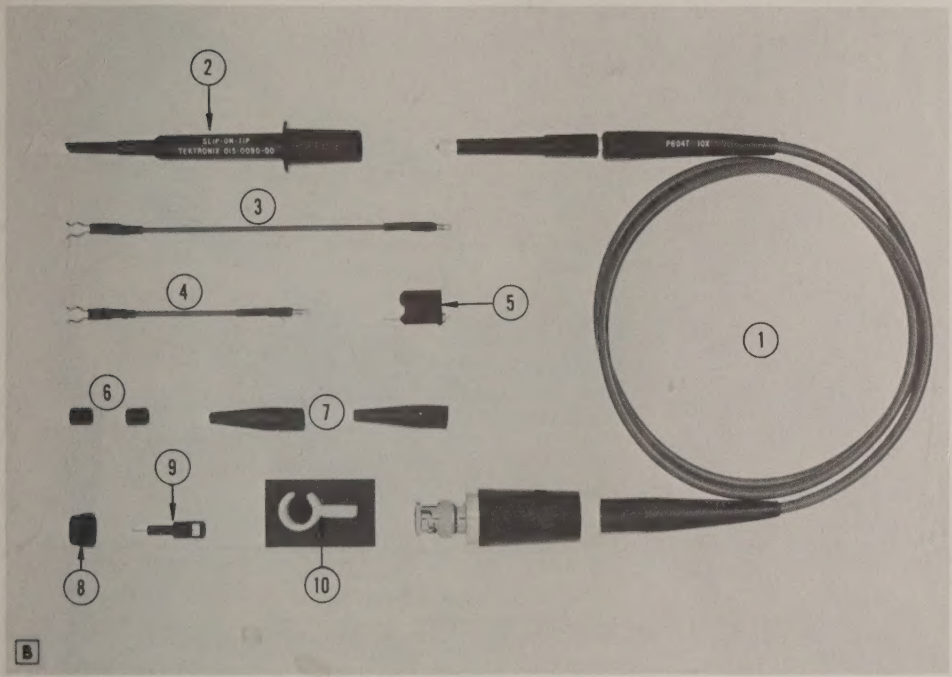
ELECTRICAL PARTS 6-FOOT CABLE

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description			
				Capacitors			
				Tolerance ±20% unless otherwise indicated.			
C1[2]	281-0663-00			10.4 pF	Cer	500 V	1%
C5	281-0093-00			5.5-18 pF, Var	Cer		
C6	281-0619-00			1.2 pF	Cer	200 V	
C7	281-0634-00			10 pF	Cer	500 V	±0.25 pF
C9	281-0093-00			5.5-18 pF, Var	Cer		
				Inductors			
L1	276-0528-00			Core, Ferramic Suppressor 0.1 μH			
L3	*108-0452-00			4 turns on Ferrite			
L5	*108-0424-00			350 nH			
				Resistors			
				Resistors are fixed, composition, ±10% unless otherwise indicated.			
R1[2]	325-0021-00			9 MΩ	1/4 W	Prec	1%
R4	311-0634-00			500 Ω, Var			
R7	311-0635-00			1 kΩ, Var			
R9	311-0609-00			2 kΩ, Var			

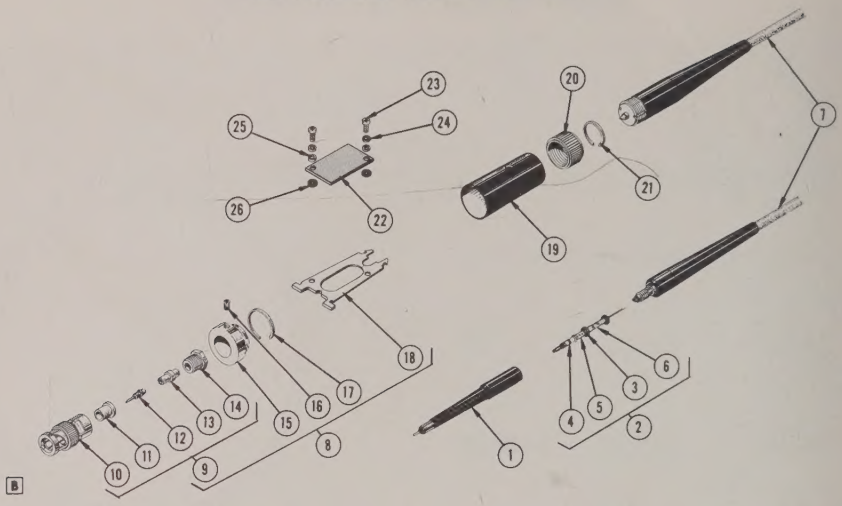
[2]Also available in Attenuator Assembly, Tektronix Part No. *206-0157-00.

PROBE and STANDARD ACCESSORIES



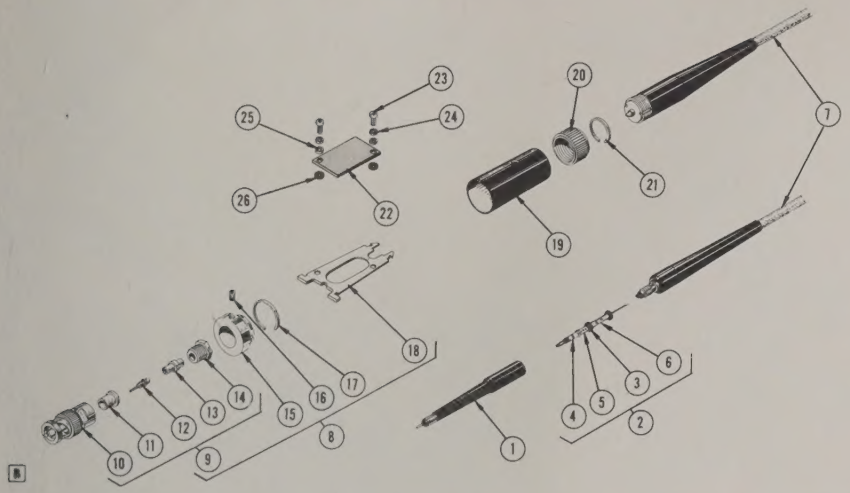
REF. NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION 1 2 3 4 5
PROBE PACKAGE					
1—10	010-0211-00			1	PROBE PACKAGE, P6047, 3.5 foot
	010-0217-00			1	PROBE PACKAGE, P6047, 6 foot
	- - - - - -			-	package includes:
PROBE ONLY					
1	010-0212-00			1	PROBE, P6047, 3.5 foot
	010-0218-00			1	PROBE, P6047, 6 foot
STANDARD ACCESSORIES					
2	013-0085-00			1	ADAPTER, bayonet GR
3	200-0372-00			1	CAP, protective
4	206-0114-00			1	TIP, probe
5	166-0404-00			2	TUBE, insulating, molded
6	344-0046-00			2	CLIP, probe
7	352-0090-00			1	HOLDER, probe, molded
8	175-0124-00			1	CABLE, ground lead, 5 inch
9	175-0263-00			1	CABLE, ground lead, 3 inch
10	013-0090-00			1	HOOK TIP, retractable
	166-0433-00	X6746		1	SLEEVE, insulating, gnd strap (not shown)
	006-0351-00			1	BAG, plastic, 4 x 6 inches (not shown)
	070-0628-01			1	MANUAL, instruction (not shown)
	367-0105-00	X6926		1	HANDLE, hook tip (not shown)

REPLACEABLE PARTS (3.5 foot)



REF. NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY. 1 2 3 4 5	DESCRIPTION
	010-0212-00			1	PROBE, P6047, 3.5 foot
	- - - - - -			-	probe includes:
1	204-0252-00			1	BODY AND SLEEVE ASSEMBLY
2	206-0147-00			1	ASSEMBLY, attenuator
	- - - - - -			-	assembly includes:
3	210-1004-00			2	WASHER, guide
4	214-0592-00			1	CONTACT, wire form
5	- - - - - -			1	CAPACITOR, C1
6	- - - - - -			1	RESISTOR, R1
7	175-0406-00			1	CABLE ASSEMBLY, 3.5 foot
8	015-0097-00			1	ASSEMBLY, compensating box
	- - - - - -			-	assembly includes:
9	131-0428-00			1	ASSEMBLY, connector, BNC
	- - - - - -			-	assembly includes:
10	134-0044-00			1	PLUG, probe, BNC
11	358-0072-00			1	BUSHING, insulator, BNC 0.323 inch long
12	214-0109-01			1	PIN, probe contact, male
13	166-0217-00			1	TUBE, spacer, insulator
14	132-0081-00			1	NUT, BNC
15	354-0270-01			1	RING, front
	- - - - - -			-	mounting hardware: (not included w/ring)
16	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
17	354-0273-00			1	RING, external, 0.625 inch ID
18	441-0712-00			1	CHASSIS, compensating box
19	200-0721-00			1	COVER, compensating box
20	354-0271-00			1	RING, locking
21	354-0272-00			1	RING, external, 0.467 inch ID
22	670-0132-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	388-0836-00			1	BOARD, circuit, unwired
	- - - - - -			-	mounting hardware: (not included w/assembly)
23	211-0079-00			2	SCREW, thread forming, 2-56 x 3/16 inch, PHS
24	210-0053-00			2	LOCKWASHER, split, #2
25	210-1008-00			2	WASHER, flat, 0.090 ID x 0.188 inch OD
26	210-0906-00			2	WASHER, fiber, 1/8 ID x 13/64 inch OD
	214-0939-00			1	INSULATOR, fish paper (not shown)

REPLACEABLE PARTS (6 foot)



REF. NO.	TEKTRONIX PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY 1 2 3 4 5	DESCRIPTION
	010-0218-00			1	PROBE, P6047, 6 foot
	- - - - - -			-	probe includes:
1	204-0252-00			1	BODY and SLEEVE ASSEMBLY
2	206-0157-00				ASSEMBLY, attenuator
	- - - - - -			-	assembly includes:
3	210-1004-00			2	WASHER, guide
4	214-0592-00				CONTACT, wire form
5	- - - - - -			1	CAPACITOR, C1
6	- - - - - -			1	RESISTOR, R1
7	175-0427-00			1	CABLE ASSEMBLY, 6 foot
8	015-0097-00			1	ASSEMBLY, compensating box
	- - - - - -			-	assembly includes:
9	131-0428-00			1	ASSEMBLY, connector, BNC
	- - - - - -			-	assembly includes:
10	134-0044-00			1	PLUG, probe, BNC
11	358-0072-00			1	BUSHING, insulator, BNC, 0.323 inch long
12	214-0109-01			1	PIN, probe contact, male
13	166-0217-00			1	TUBE, spacer, insulator
14	132-0081-00			1	NUT, BNC
15	354-0270-01			1	RING, front
	- - - - - -			-	mounting hardware: (not included w/ring)
16	213-0020-00			1	SCREW, set, 6-32 x 1/8 inch, HSS
17	354-0273-00			1	RING, external, 0.625 inch ID
18	441-0712-00			1	CHASSIS, compensating box
19	200-0721-00			1	COVER, compensating box
20	354-0271-00			1	RING, locking
21	354-0272-00			1	RING, external, 0.467 inch ID
22	670-0153-00			1	ASSEMBLY, circuit board
	- - - - - -			-	assembly includes:
	388-0863-00				BOARD, circuit, unwired
	- - - - - -			-	mounting hardware: (not included w/assembly)
23	211-0001-00			2	SCREW, 2-56 x 1/4 inch, RHS
24	210-0053-00			2	LOCKWASHER, split, #2
25	210-1008-00			2	WASHER, flat, 0.090 ID x 0.188 oinch OD
26	210-0906-00			2	WASHER, fiber, 1/8 ID x 13/64 inch OD
	214-0939-00			1	INSULATOR, fish paper (not shown)

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